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3D Volumetric Visualization of MRI Images

Toral S Patel[1], Prof. Prasant B Swadash[2], Prof. Nikhil P Patel[3]
[1, 2] *BVM Collage,* [3]*BBIT V.V. Nagar*

Abstract: ***MRI (Magnetic resonance imaging) is medical images, also known as nuclear magnetic resonance imaging. MRI is scanning technique which gives detail information and images of human body. Three-dimensional volume rendering has potential to simplify standard radiological study. In fact, although a two- dimensional (2D) image series allows a radiologist of moderate skill to draw all the necessary conclusions, 3D visualization images allowing radiologists and clinicians to make a correct diagnosis. .Number of 2D images will collect together and visualize 3D model. In our work we apply volume rendering on MRI images and after by marching cube create facet and voxels which represent 3D model. Then voxels are projected and visualize like 3D image and with different iso value results are generated.***
Keywords: Volume rendering, Magnetic Resonance imaging (MRI), Marching cube, iso value.

I. INTRODUCTION

Medical imaging and their visualization mostly provide efficient mean to reveal the relations between function. Visualization of Medical imaging will give behavior and organization of biological organs and play a most hard and important role in medical diagnosis for radiologist and surgery[2].For 3D MRI , visualization of images ,and also interaction and observation would be complicated. Volume rendering technique is most used for generating 3D volume from 2D volume data and can be applied to visualization of 3D cardiac MRI data. However, the variety and complexity of any inner tissue in MRI such like brain and cardiac makes it very difficult and challenging to visualize 3D. For render the 3D image directly, those cross sectional slices stacked with each other to form 3D array of elements. Each element of the array comprises a density and is considered a grid point in 3D space and if the grid points are not distributed then , it is directly often to convert them to a regular format by interpolation [5]. Currently, there are two classes of volume rendering techniques which could be applied to visualization of 3D MRI data. Both direct rendering and classification-based rendering . In classification-based volume rendering, a segmentation process is introduced to assign each volumetric pixels a specific object category [2].With the help of transfer function, direct volume rendering gives an approach to explore large 3D data sets, and thus could alleviate the difficulty in cardiac tissue segmentation. Transfer functions, which assign appropriate optical properties to the voxels, are of great importance for direct volume rendering [4]. However, transfer function design is difficult. By far, there is no one proper solution which gives us perfect and satisfactory . Information flow for 3d medical algorithm. Medical applications of 3D have four steps .

A. Data Acquisition.

Here is firs step that performed by the medical imaging hardware, samples some property in a patient and generate multiple 2D slices of information. For 3D realistic applications , CT is frequently used mostly for bone structure, although we have had success visualizing soft tissue. Magnetic resonance (MR) measures three physical properties.

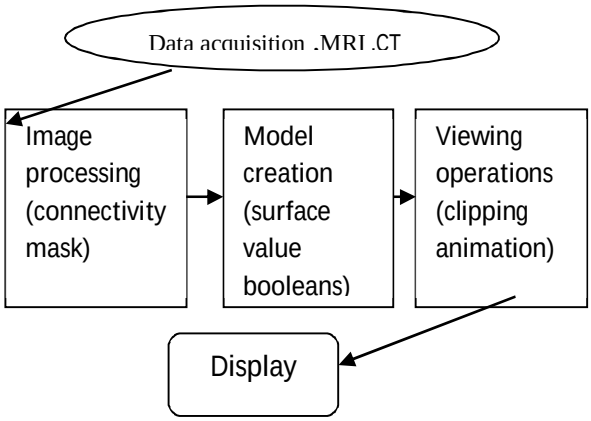

Figure 1 3D medical information flow.

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B. Image Processing

Some algorithms use image processing techniques to find structures within 3D data . Here in this step filtering of original data is done.so MR data needs image processing to for selecting appropriate result and get good quality of model.

C. Surface Construction

In this step, surface construction ,this involves generation of surface model for 3d data, with using different kind of algorithm.
The model usually consists of 3D volume elements (voxels) or polygons. Desired surface would selected by users where density value must be specified.
This step is creation of cut or capped surface medium.

D. Display

Having created the surface, the final step displays that surface using display also include rendering technique which is ray casting ,depth shading and color shading[4].

II. RELATED WORK

There are several ideas for how to reconstruct 2D images of medical images into a 3d model and visualize it. There are main three types of 3D rendering techniques such as surface rendering, volume rendering and multiplaner rendering. but here in case most commonly used techniques are surface rendering and volume rendering because it produce better result as compare to multiplanar rendering using some of calculations. Surface rendering technique most used for 3D generation where 2D images visualized a 3D object as a set of surfaces called as an iso-surface. Each surface contains point whch are calculated by mash grid generation which have some intensity called iso value on all slices. Two main methods for reconstructing iso-surface are contour and voxesl based reconstruction[2]

A. Two type of rendering process are possible.

1) Online rendering: Real-time rendering used most in gaming and interactive graphics.
2) Offline rendering: Pre-rendering used when speed is not constrain for rendering and all calculation mostly done by multi core CPU rather than dedicated graphics hardware.

Another research by Delibasis et al [6], proposed an improved Marching Cubes with additional cases. This study stated that standard Marching cube algorithm has the occasional ‘hole problem’, and also large number of produced triangles called facets and computational overhead by the cube rotations. It is used most 15 predefined cube configurations that reduces the number of original configurations (256) can produce topologically surface which covered all vertex points and count it well by 15 mechanism, or ‘holes’ in some king of slices of two adjacent cubes similarly. And on gird problem disetrich suggested use of edge transformations for improvement of mesh quality of marching cubes.one of shortcoming of standard marching cube is the quality of resulting meshes and which have many more poorly shaped and degenerated triangles because of some reasons gird size, some point missed in gird. So this research proposed a method to modify the grid on marching cube which increased quality of extracted mesh.
N.p. patel [1],a rendering concept for medical images such MRI images on cardiac based on different iso value concept. Using marching cube algorithm voxels are generated and arranged and projected for visualize of a 3D scene. and approximate processing time for different iso values are also compared in this paper. they used voxel based generation of iso surface with surface rendering. also have difference table for simulation processing time for particular iso value 10,30,80,100 and with open Gl and without OpenGL.

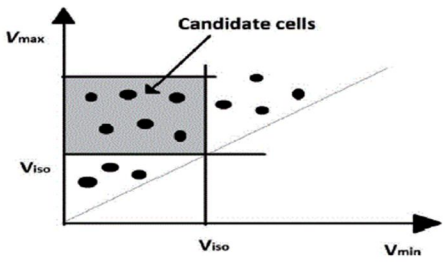

Figure 2: Iso selection

In figure ,the lowest which is Vmin and highes means Vmax vertex value are represented by a point in space. given iso value ,only consider that satisfy both condition (vmin<=Viso and Vmax >=Viso)and also contain the isosurface are going for further processed .

III. METHODOLOGY

Marching cube is a high quality resolution 3D surface constructing algorithm which well-known cell by cell method for extracting an isosurface from a scalar volumetric data.

A. Voxel Creation

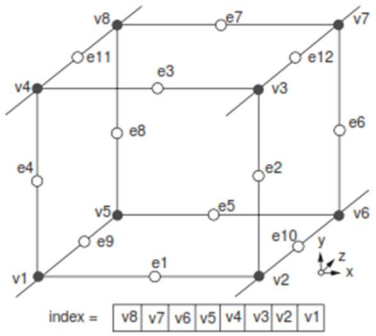

Figure 3: creation of voxels

$$e_{ij} = \frac{(1+v_j)\,j - v_j.i}{v_i - v_j} \quad \text{.....(1)}$$

Where i,j=0,1,2

Marching cubes comprises two principal steps: the intersection of the surface is detected within a local cube generated by eight voxel samples; thereafter the surface within the cube is represented by triangles and their vertex locations computed. Following these steps. We March to the next cube and repeat the process until the entire voxel space has been triangulated. In order to determine the local intersection configuration, we must first determine how each *vertex* of the cube is positioned with respect to the surface we are attempting to extract. Each vertex can be in one of two states, inside the surface (including being on the surface) or outside the surface. We assign either a one or a zero to each vertex depending on whether it isin the inside or outside state respectively.

B. Marching Cube Algorithm

When polygon a field where values and points known or interpolated anywhere in space is resolution of sampling grid, it allow fine or near by approximation shape to iso surface to be created depending on smoothness required.

Higher grid size will give rough shape and generate less facets as opposite less grid size will give a good shape with more number of facets. It used divide-and-conquer approach to locate surface in the cube which is created from eight pixels (figure 4).algorithm determine how surface intersects this cube and then moves to next cube.

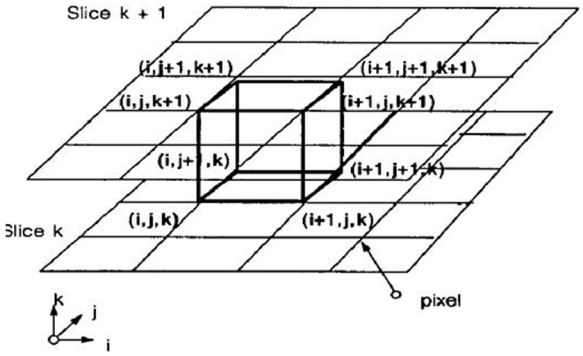

Figure 4: Marching cube

Total eight vertices in each cube .Two states inside and outside,2^8=256 ways a surface can intersect the cube .Reducing number of cased to 128 using symmetry property, rotational symmetry ,here reduced problem to 14 patters by inspection. Below figure shows.

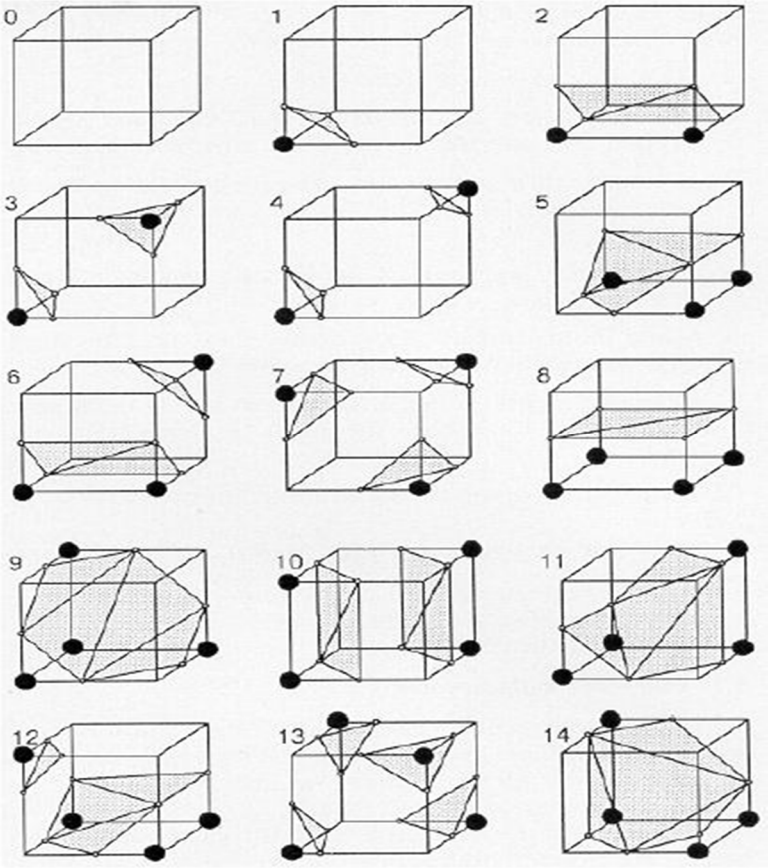

Figure 5: 15 marching cube[2]

IV. CONCLUSION

To improve quality of 3D model of mri data such image pre-processing is needed such like medial filter and high boost filter. This algorithm use a case table of edge intersections which shows ho a surface cuts through each cubes in 3D data. Marching cube is best algorithm for rendering images and to create 3D model. For effective visulatization volumetric rendering with ray casting and iso surface rendering is used. Help radiologist for pre-diagnosis. Taking more MRI 2d images will produce good result but still required improvement in smoothing surface.

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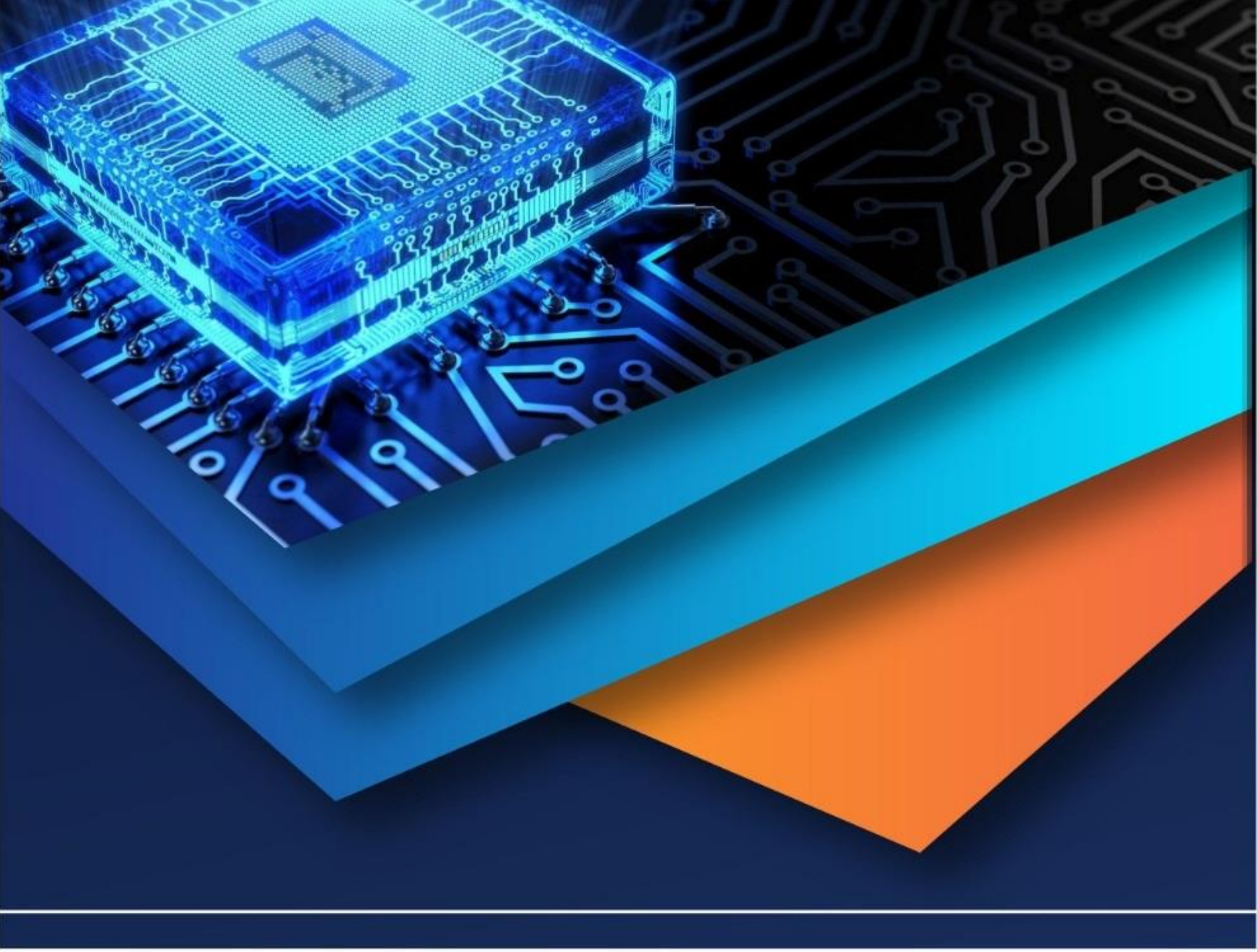

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